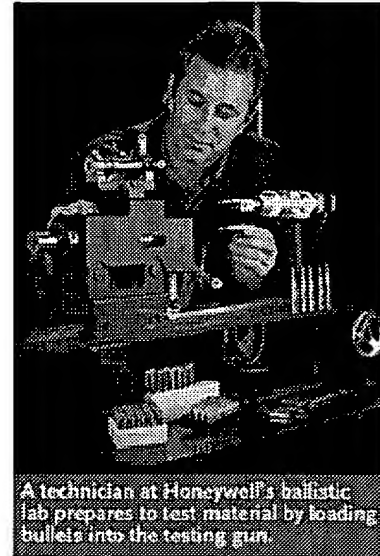




## History of Spectra® Fiber and Shield Technology

In the mid 1980s, AlliedSignal Inc. (now Honeywell) introduced Spectra® fiber. An entirely new type of synthetic yarn, it was one of the first commercially available extended chain, high-modulus polyethylene fiber. Because Spectra® fiber is a polyethylene—with a carbon-to-carbon molecular structure like that of a diamond—it creates a continuous filament yarn with incredible performance and endurance. Pound-for-pound ten times stronger than steel yet light enough to float, Spectra® fiber is one of the world's strongest and lightest manmade fibers. Spectra® fiber applications include **cut protection, ropes and cordage, vehicular and personal armor, and fishing line**, as well as various **specialty applications**.

The Spectra Shield® family of composite products began with the development of Shield technology by Honeywell in the late 1980s. Shield technology lays parallel strands of synthetic fiber side by side and holds them in place with a resin system, creating a unidirectional tape. Two layers are then cross-plyed at right angles (0°/90°) and fused into a composite structure under heat and pressure. The pre-consolidated cross-plyed material is then packaged as rolls, ready for shipping.



A technician at Honeywell's ballistic lab prepares to test material by loading bullets into the testing gun.

Shield technology was originally developed utilizing only Spectra® fiber, but over the years engineers have developed Shield products using other high-performance fibers such as aramid fiber in our Gold Flex® product.

In the last 15 years Shield technology and the Spectra Shield® family of composite products have revolutionized armor systems in ballistic resistant vests and hard armor applications used by law enforcement agencies and militaries throughout the world.

### Spectra Technologies Mission

Spectra Technologies manufactures Spectra® fiber and develops performance-enriched, fiber-based technologies for applications where materials are mission-critical and when success frequently means expanding the accepted limits of performance. Spectra Technologies does this serving as a technical resource to its customers and the segments they serve.

## HIGH-STRENGTH, LIGHTWEIGHT POLYETHYLENE FIBERS

This extended chain polyethylene fiber has the highest strength to weight of any manmade fiber. Spectra fiber's high tenacity makes it 8 to 10 times stronger than steel and 40 percent stronger than aramid fiber.

With outstanding toughness and extraordinary visco-elastic properties, Spectra fiber can withstand high-load strain-rate velocities. Light enough to float, it also exhibits superior resistance to chemicals, water, and ultraviolet light. It has excellent vibration damping, flex fatigue and internal fiber-friction characteristics, and its low dielectric constant makes Spectra fiber virtually transparent to radar.

Honeywell Performance Fibers also converts Spectra fiber into Spectra Shield® specialty composites for armor and other applications.

### Physical Properties

(Nominal)		Spectra® 900					Spectra® 1000							
Weight/Unit Length	(Denier)	650	650	1200	1600	4800	215	275	375	435	550	650	1100	1300
	(Decitex)	722	722	1333	1778	5333	239	306	417	483	611	722	1222	1444
Ultimate Tensile Strength	(g/d)	28	30.5	30	27	25.5	38	36	35	34.5	38	36	36	35
	(gpa)	2.40	2.61	2.57	2.31	2.18	3.25	3.08	3.00	2.95	3.25	3.08	3.08	3.00
Breaking Strength	(lbs.)	40.1	44	79	95.2	270	18.0	21.8	28.9	33.1	46.1	51.6	87.3	100.3
	(gpa)	2.40	2.61	2.57	2.31	2.18	3.25	3.08	3.00	2.95	3.25	3.08	3.08	3.00
Modulus	(g/d)	775	920	850	720	785	1320	1320	1200	1180	1300	1175	1250	1150
	(gpa)	66	79	73	62	67	113	113	103	101	111	101	107	98
Elongation	(%)	4.1	3.6	3.6	4.4	3.9	2.9	3.1	3.1	3.2	3.1	3.3	3.3	3.4
Density	(g/cc)	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
	(lbs/in <sup>3</sup> )	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
Filament/tow		60	60	120	150	480	60	60	60	120	120	120	240	240
Filament	(dpf)	10.8	10.8	10.0	10.7	10.0	3.6	4.6	6.3	3.6	4.6	5.4	4.6	5.4



- Police and military ballistic vests, helmets and hard-armor for vehicles and aircraft.
- Marine lines and commercial fishing nets.
- Industrial cordage and slings.
- Cut-resistant gloves and slash-resistant protective gear.
- Composites for abrasion protection and impact resistance.
- Sail cloth, fishing line and other leisure applications.

Although Honeywell International Inc. believes that the suggestions regarding the possible uses of the products as well as the other statements contained in this publication are accurate and reliable, they are presented without guarantee or responsibility of any kind and are not representations or warranties of Honeywell International Inc, either express or implied. Information provided herein does not relieve the user from the responsibility of carrying out its own tests and experiments and the user assumes all risks and liability (including, but not limited to, risks relating to results, patent infringement and health, safety and the environment) for the results obtained by the use of the products and the suggestions contained herein.

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